THE WEATHER AND CIRCULATION OF FEBRUARY 1954 [1]

The Warmest February on Record for the United States

ARTHUR F. KRUEGER

Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.

TEMPERATURE AND CIRCULATION

The month of February 1954 was characterized by extreme warmth over most of the United States, particularly in the North where average temperatures ranged as high as 20° F. above normal in the Dakotas and 10° above in Maine (Chart I–B). This was the warmest February on record for many parts of the Northern Plains, the Northeast, and the Great Lakes region and the warmest since 1930 for much of the Central and Southern Plains. For the country as a whole the weighted temperature average was higher than for any pervious February in the 61-year period of record. Furthermore, many stations reported record high daily temperatures during the month. In parts of Texas temperatures of 90° F. or greater occurred on two or three afternoons with extremes of 96° F. at Corpus Christi, 94° at Brownsville, and 93° at Austin.

This abnormal warmth was related to the fact that monthly mean 700-mb. heights were above normal over all the United States except the extreme Southeast (fig. 1). The largest departures for the country (+280 ft.) were observed in the Great Basin in the vicinity of a well developed 700-mb. ridge and an abnormally strong Basin High at the surface (Chart XI and inset). On the other hand, in Alaska, northwestern Canada, and the adjacent Arctic Ocean, subnormal 700-mb. heights and sea level pressures occurred accompanied by a greatly weakened surface polar anticyclone. In fact, in the Arctic Ocean north of Alaska a closed low center replaced the normal ridge, with the resulting anomalies (−550 ft. at 700 mb., −18 mb. at surface) being the lowest that have ever been noted for this region during the years of available data. The presence of negative height anomalies in northwestern Canada is concomitant with warmth over much of the United States, as emphasized by Martin [1].

In the eastern Pacific below normal heights were associated with a trough extending from Alaska southward to the Hawaiian Islands. East of this trough stronger than normal southwesterly flow carried warm Pacific air across the coasts of Washington and British Columbia, after which it was further heated during descent over the eastern slopes of the Rockies. The average speeds in this current were about 14–16 m/sec. and were as much as 8 m/sec. above normal (fig. 2 A and B). The unusually fast flow across Canada left little opportunity for this Pacific air to be transformed into polar continental air; thus the mean polar High was weak (Chart XI) and there were few cold-air outbreaks penetrating the United States. In the Northeast above normal temperatures were enhanced by anomalous flow from the southeast to the rear of an abnormally strong ridge in mid-Atlantic (anomaly of +430 ft. at 700 mb. and +12 mb. at sea level).[2]

The strength of the westerlies over Canada and the corresponding weakness of the polar anticyclone may be related to the circulation upstream. To the east of an abnormally strong ridge in northeastern Siberia (fig. 1) cold air was swept southward into the central Pacific where it interacted with warmer air forming a confluence zone [2]. Numerous cyclonic disturbances originated in this frontogenetical region and moved rapidly eastward to the Canadian coast (Chart X). Many of these storms either crossed the mountains or induced cyclogenesis on the lee side; as a result cyclonic activity was greater than normal in most of Canada. These storms traveled, for the most part, to the left of the axis of strongest winds at 700 mb. in the region of cyclonic shear.

PRECIPITATION

Subnormal precipitation over most of the country (Chart III) was associated with a ridge over the Basin, fast westerlies in Canada, and a trough along the east coast (fig. 1). The resulting anomalous flow from the Rockies eastward to the Atlantic Coast was from the north and because of subsidence and low humidities within this current, little precipitation occurred. Especially noticeable was the lack of any measurable precipitation in western and southern Texas, while much of the remainder of the State reported less than 10 percent of the normal amount, as did also parts of Colorado, Wyoming, Nebraska, and Kansas. This month was the driest February since 1901 at Brownsville, Tex., the driest

[1] See Charts I–XV following p. 72 for analyzed climatological data for the month.

[2] The anomalous flow is simply the vector deviation of the monthly mean geostrophic wind from the monthly normal and is represented by the isopleths of the departure from normal height field (dashed lines in fig. 1).

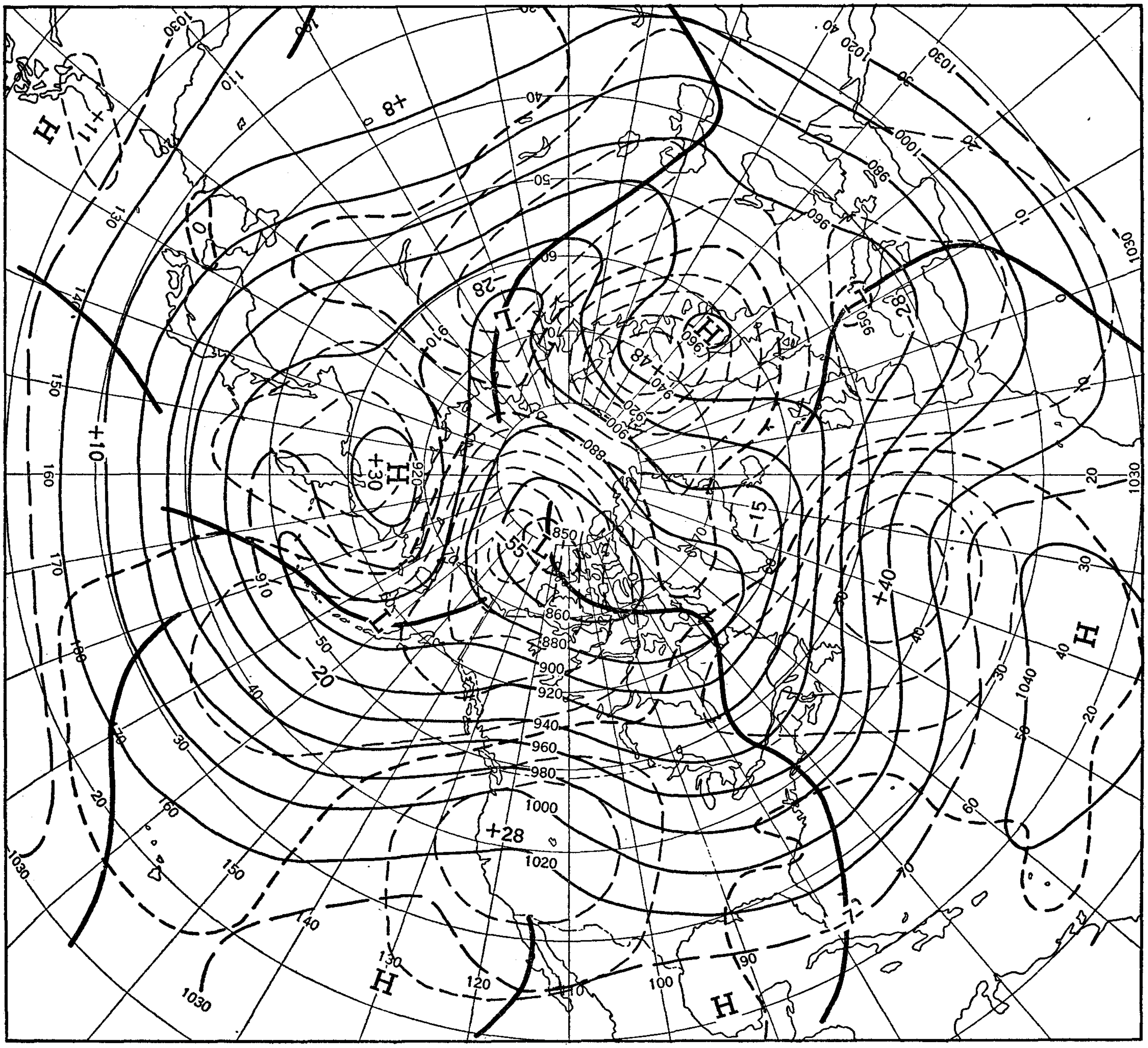


FIGURE 1.—Mean 700-mb. height contours and departures from normal (both in tens of feet) for January 30–February 28, 1954. Heights were below normal in Alaska, northwest Canada, and the adjacent Arctic Ocean, but were above normal over most of the United States.

since 1916 at San Antonio, and the second driest February on record at Corpus Christi. By the end of the month, 11 weeks had elapsed without substantial precipitation for much of the Central and Southern Plains, and the resulting drought situation was further aggravated by unseasonably warm temperatures and high winds which evaporated much of the soil moisture. In addition, the high winds caused considerable soil-blowing and even duststorms reminiscent of the 1930's.

Precipitation in significant amounts took place primarily in parts of the Central Plains, the Great Lakes region, the Northeast, the Pacific Northwest, and southern Florida. The amounts in the Northeast were associated with a strong anomalous flow of warm moist air just to the east of the mean trough. In the Pacific Northwest excess precipitation occurred as strong southwesterlies were forced over the coastal ranges, while in southern Florida heavy rains may be attributed to cyclonic curvature and resulting convergence in a deeper than normal trough.

Not as easily explained from figure 1 are the large precipitation amounts occurring in the Central Plains and Great Lakes region. These amounts, however, were the result of a change in the circulation during the latter half of the month, as illustrated in figure 3. While the mean trough was found in the central Pacific during the

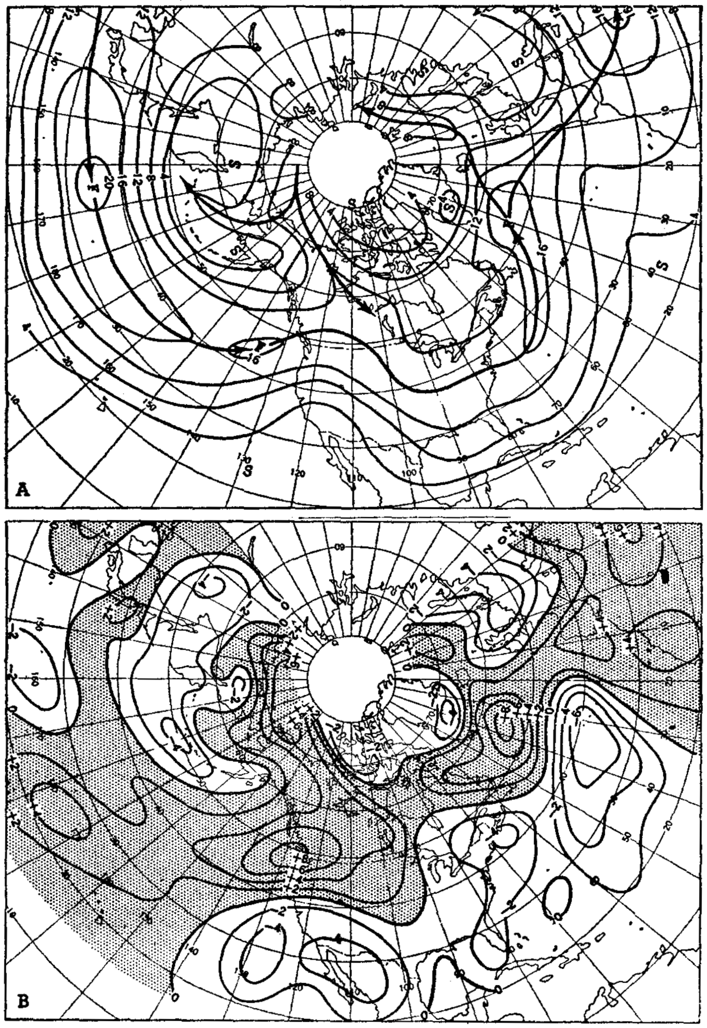


FIGURE 2.—(A) Mean 700-mb. isotachs and (B) departure from normal wind speed (both in m/sec.) for February 1954. Solid arrows indicate average position of maximum westerlies. The westerlies were stronger than normal over most of Canada and Alaska.

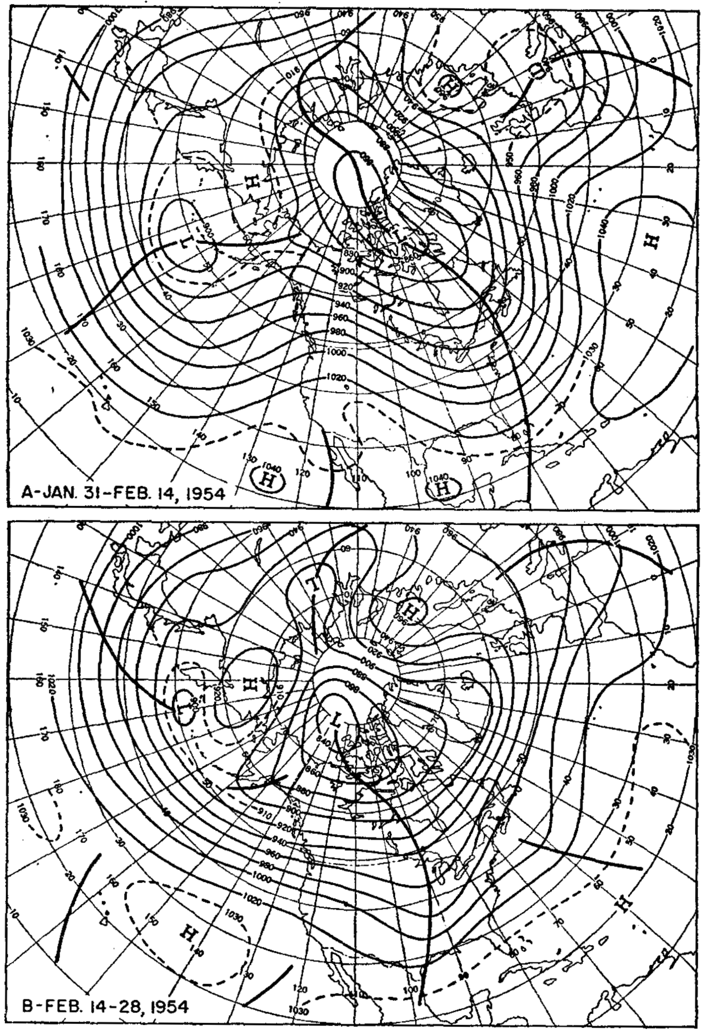


FIGURE 3.—Mean 700-mb. contours for 15-day periods (A) January 31—February 14, 1954 and (B) February 14–28, 1954. A westward shift of the Pacific trough was accompanied by a westward shift of the North American trough to the middle of the continent.

first half of the month (fig. 3*A*), it shifted to the western Pacific during the last half of the month (fig. 3*B*), accompanied by a corresponding westward shift in position of the North American trough. Once this occurred, many places in the eastern part of the country experienced their first significant precipitation amounts of the month as moist Gulf air was carried northward ahead of the trough [3] in the central United States. Anomalous flow from the south, responsible for this precipitation, is indicated in figure 4*B*, which is the departure from normal of the 15-day mean 700-mb. heights shown in figure 3*B*. A striking contrast is provided by figure 4*A*, the departure from normal of the 700-mb. heights in figure 3*A*, where the anomalous flow is strongly from the north.

Table 1 compares the precipitation during the last half of the month with the monthly total for a few stations affected by the westward shift in trough position. It shows that nearly all of the monthly precipitation for these stations took place during the last half of the month when the trough was in the central part of the country.

The amplitude of this trough and the anomalous southerly flow to its east were considerably greater in the North than in the South. As a result precipitation amounts, and presumably upward motion, were large in the Great Lakes region but relatively small along the Gulf Coast [3, 4]. Above normal amounts in eastern Nebraska and western Iowa resulted essentially from one cyclone (Feb. 19–20). Omaha, for example, received 2.24 inches, or 87 percent of its monthly precipitation, from this one storm, which

TABLE 1.—*Precipitation at selected stations for February 1954*

	Total for month (in.)	Amount occurring last half of month (in.)	Percent occurring last half of month
Memphis, Tenn	4.97	4.97	100
Atlanta, Ga	2.70	2.50	93
Columbus, Ohio	1.78	1.70	96
New Orleans, La	1.34	1.32	99
Shreveport, La	.90	.90	100
Omaha, Nebr	2.59	2.59	100
Grand Rapids, Mich	2.71	2.27	84

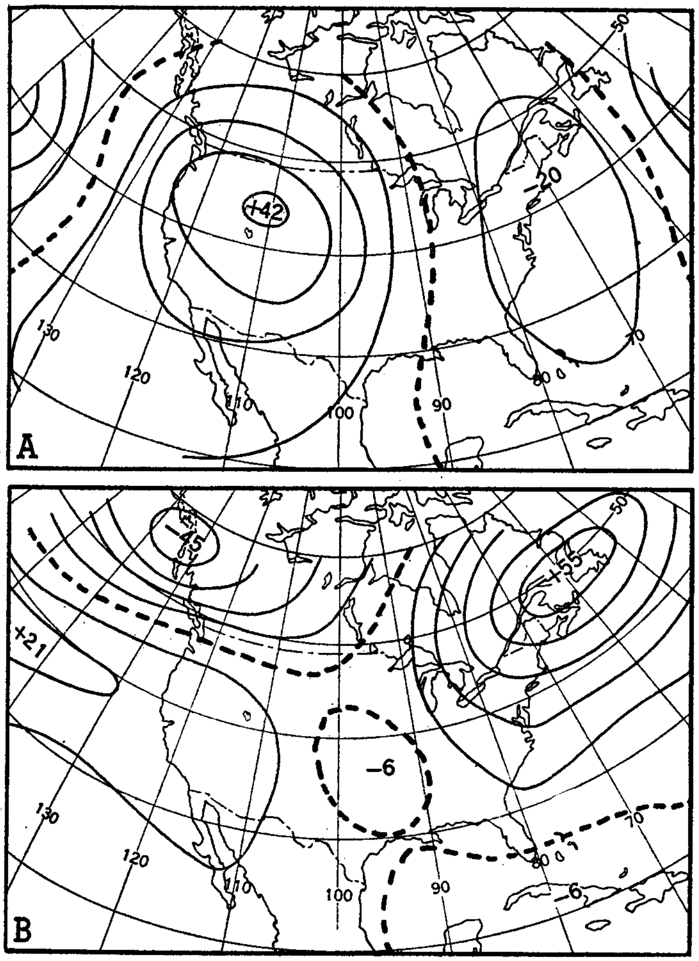


FIGURE 4.—Mean 700-mb. height departures from normal for 15-day periods (A) January 31-February 14, 1954, and (B) February 14-28, 1954. Isopleths are drawn for intervals of 100 ft. with zero line dashed and anomaly centers labeled in tens of feet. Strong anomalous northerly flow prevailed in the East during the first half of the month followed by a reversal to southerly the last half of the month.

was the greatest amount for any 24-hour period for any winter month on record. Furthermore, this made February 1954 the third wettest on record at Omaha.

BLOCKING ACTIVITY

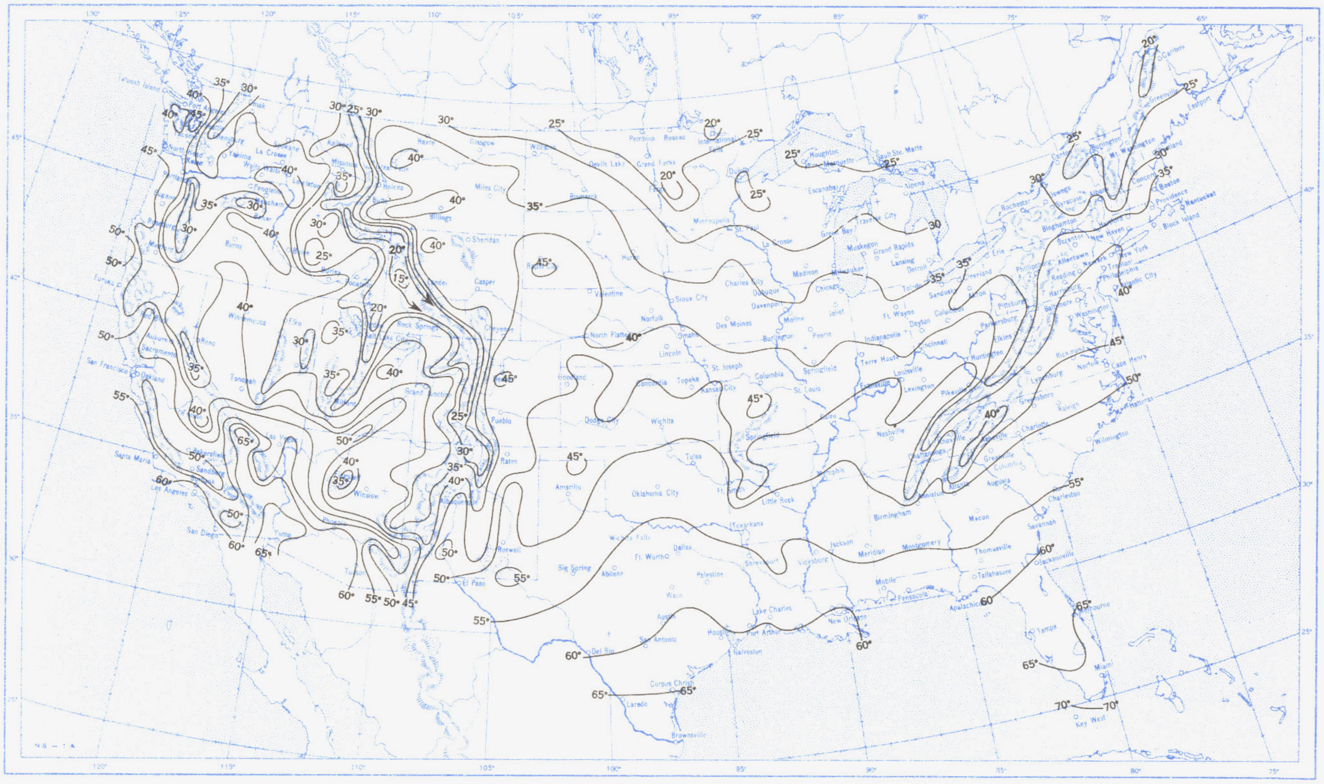
Blocking was an important factor in determining this month's circulation pattern, but to a lesser extent than during January [5]. Again there was a progressive diminution in the speed of the westerlies, originating in the eastern Atlantic and spreading westward to the western Pacific. Concurrent with the weakening of the westerlies in the eastern Pacific, strong anticyclogenesis occurred over Alaska around February 12. The resulting 5-day mean High retrograded during the following week into northeastern Siberia, where it remained for another week and slowly weakened. The mean position of the blocking High for the month as a whole was in northeastern Siberia (fig. 1), compared to a location in the Bering Sea during January [5].

Over Europe, blocking was present in varying strengths throughout the month and was well reflected in the monthly pattern (fig. 1), where anomalies of +480 ft. occurred over Scandinavia and −280 ft. in the Mediterranean. This block was particularly striking in its resemblance to the typical picture in which blocking is considered as a split in the westerlies, with one branch flowing north and the other flowing south (fig. 2A) [6].

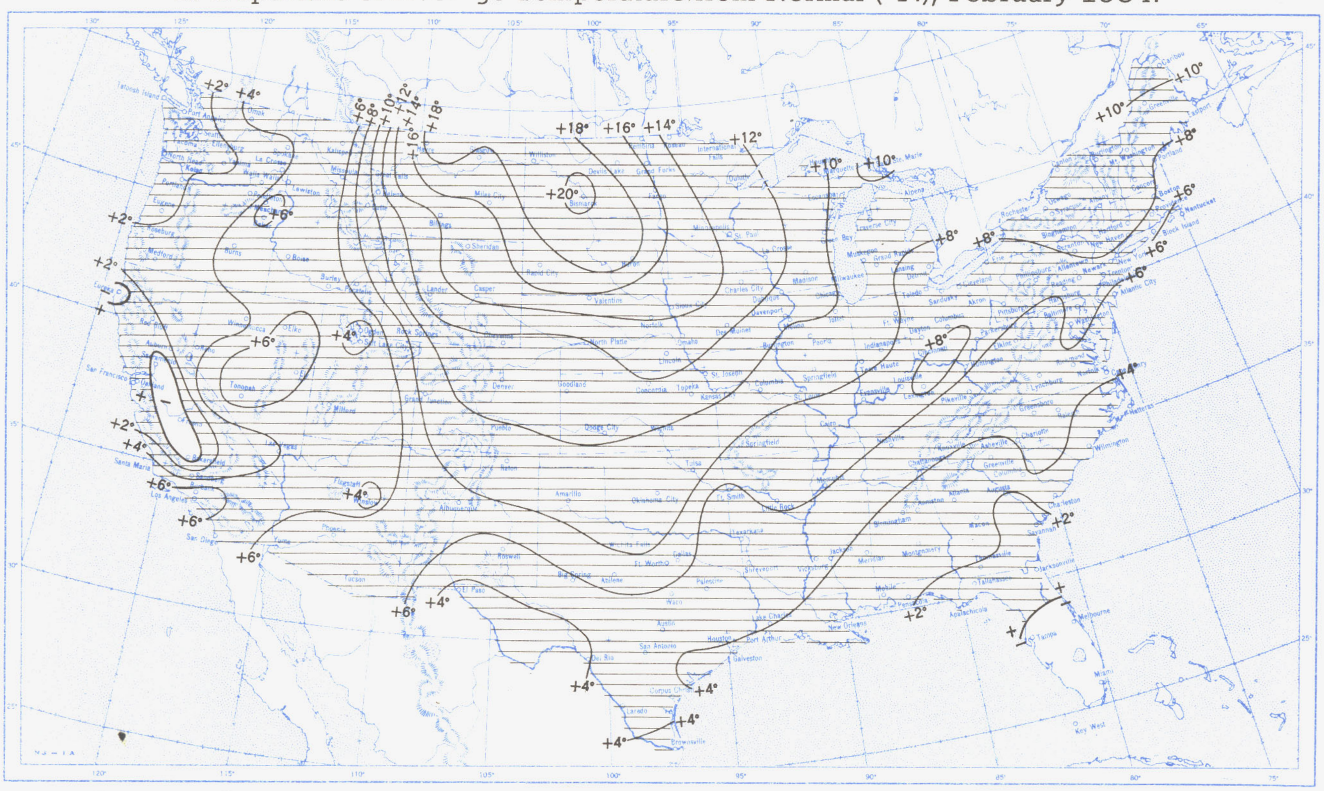
REFERENCES

1. D. E. Martin and H. F. Hawkins, Jr., "Forecasting the Weather, The Relationship of Temperature and Precipitation over the United States to the Circulation Aloft," *Weatherwise*, vol. 3, No. 1, Feb. 1950, pp. 16–19.
2. J. Namias and P. F. Clapp, "Confluence Theory of the High Tropospheric Jet Stream," *Journal of Meteorology*, vol. 6, No. 5, Oct. 1949, pp. 330–336.
3. W. H. Klein, "An Objective Method of Forecasting Five-Day Precipitation for the Tennessee Valley," U. S. Weather Bureau *Research Paper* No. 29, Apr. 1949, 60 pp.
4. J. E. Miller, "Studies of Large Scale Vertical Motions of the Atmosphere," *Meteorological Papers*, vol. 1, No. 1, New York University College of Engineering, July 1948, 48 pp.
5. A. F. Krueger, "The Weather and Circulation of January 1954—A Low Index Month with a Pronounced Blocking Wave," *Monthly Weather Review*, vol. 82, No. 1, Jan. 1954, pp. 29–34.
6. R. Berggren, B. Bolin, and C.-G. Rossby, "An Aerological Study of Zonal Motion, Its Perturbations and Break-Down," *Tellus*, vol. 1, No. 2, May 1949, pp. 14–37.

Chart I. A. Average Temperature (°F.) at Surface, February 1954.

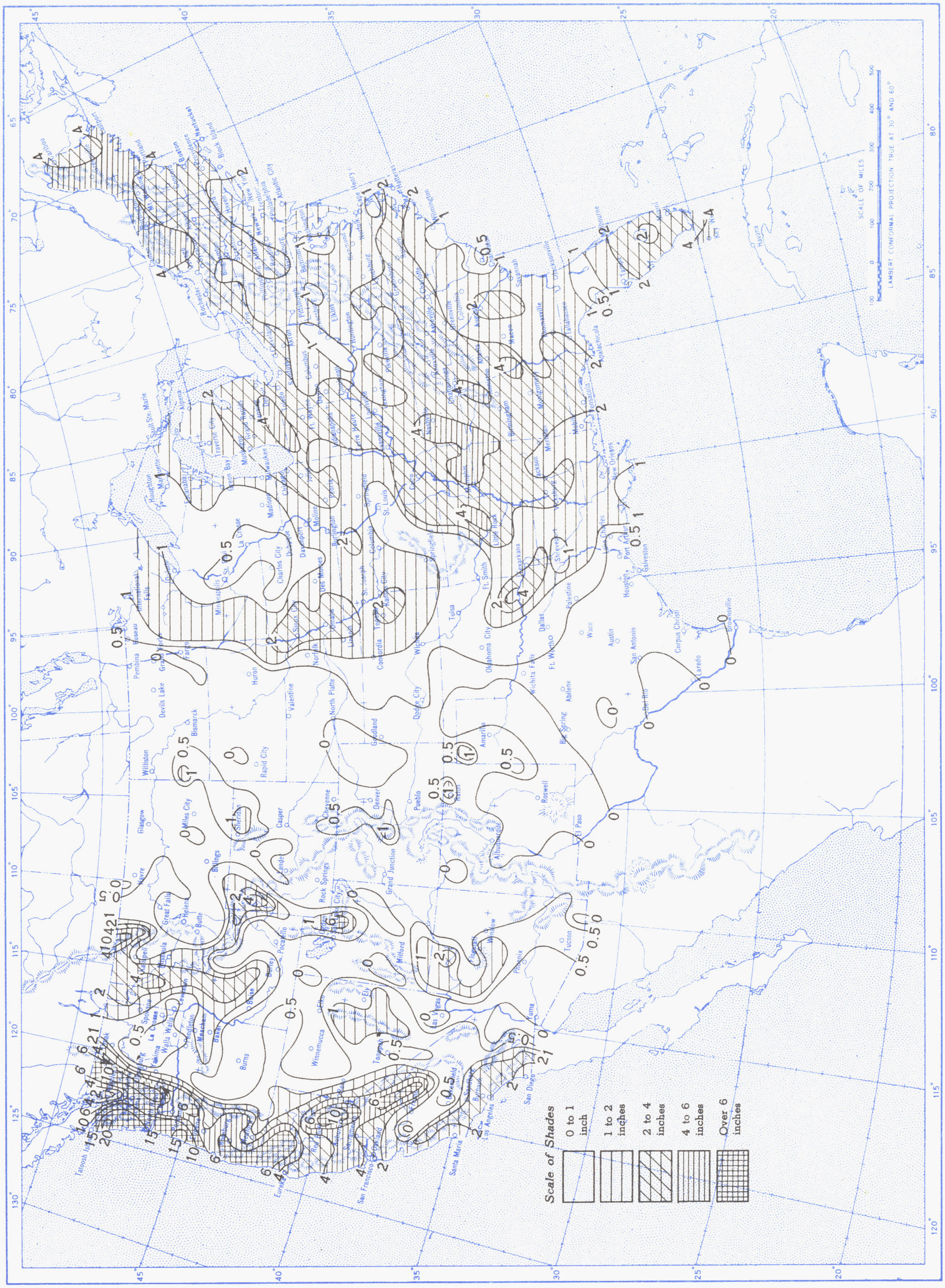


B. Departure of Average Temperature from Normal (°F.), February 1954.



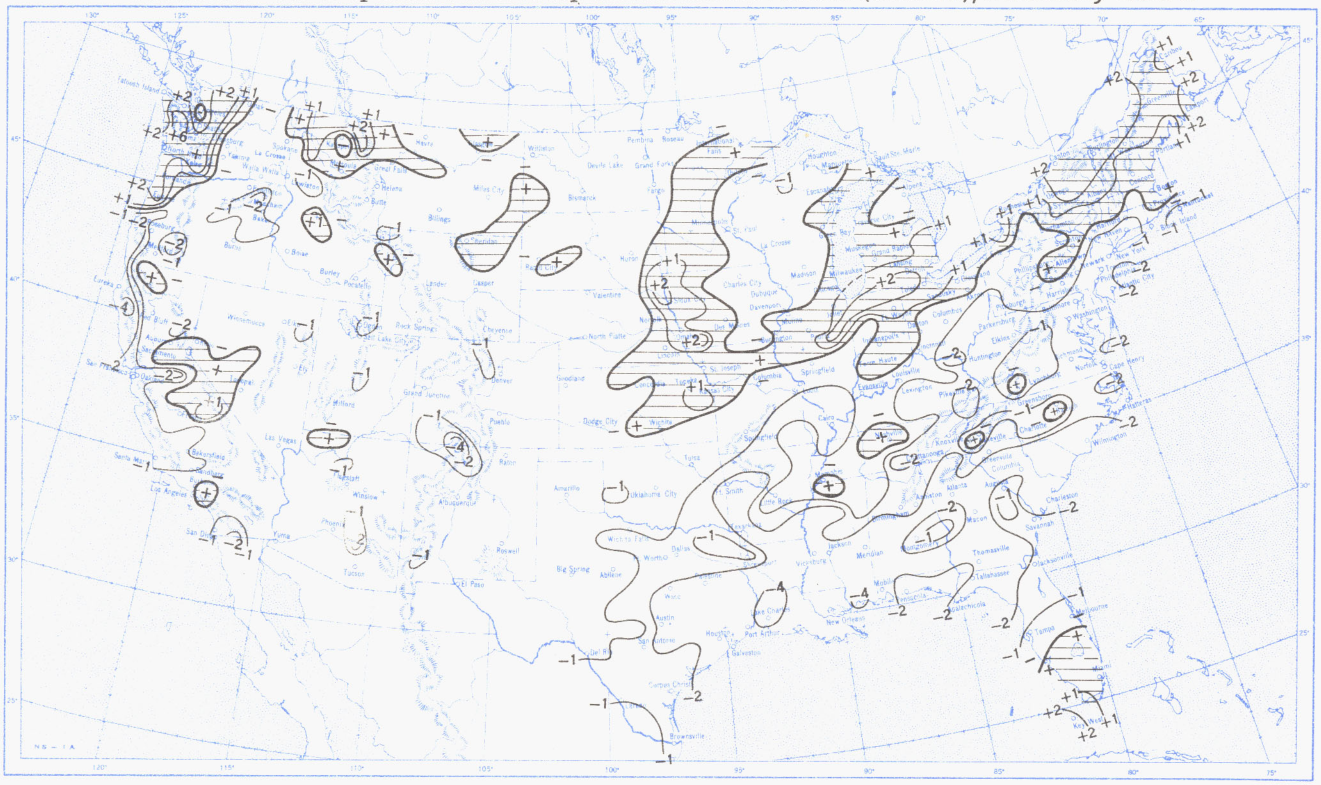
A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), February 1954.

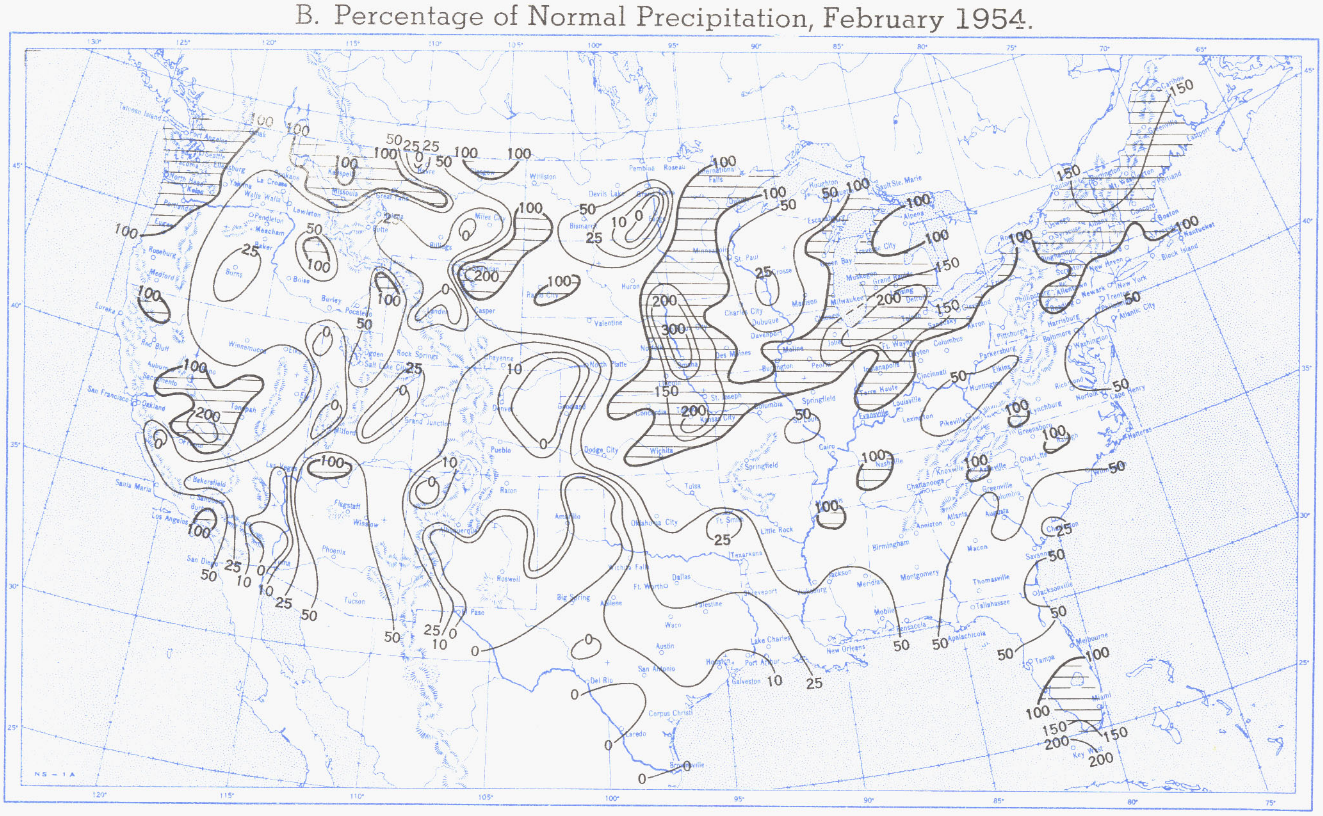


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), February 1954.

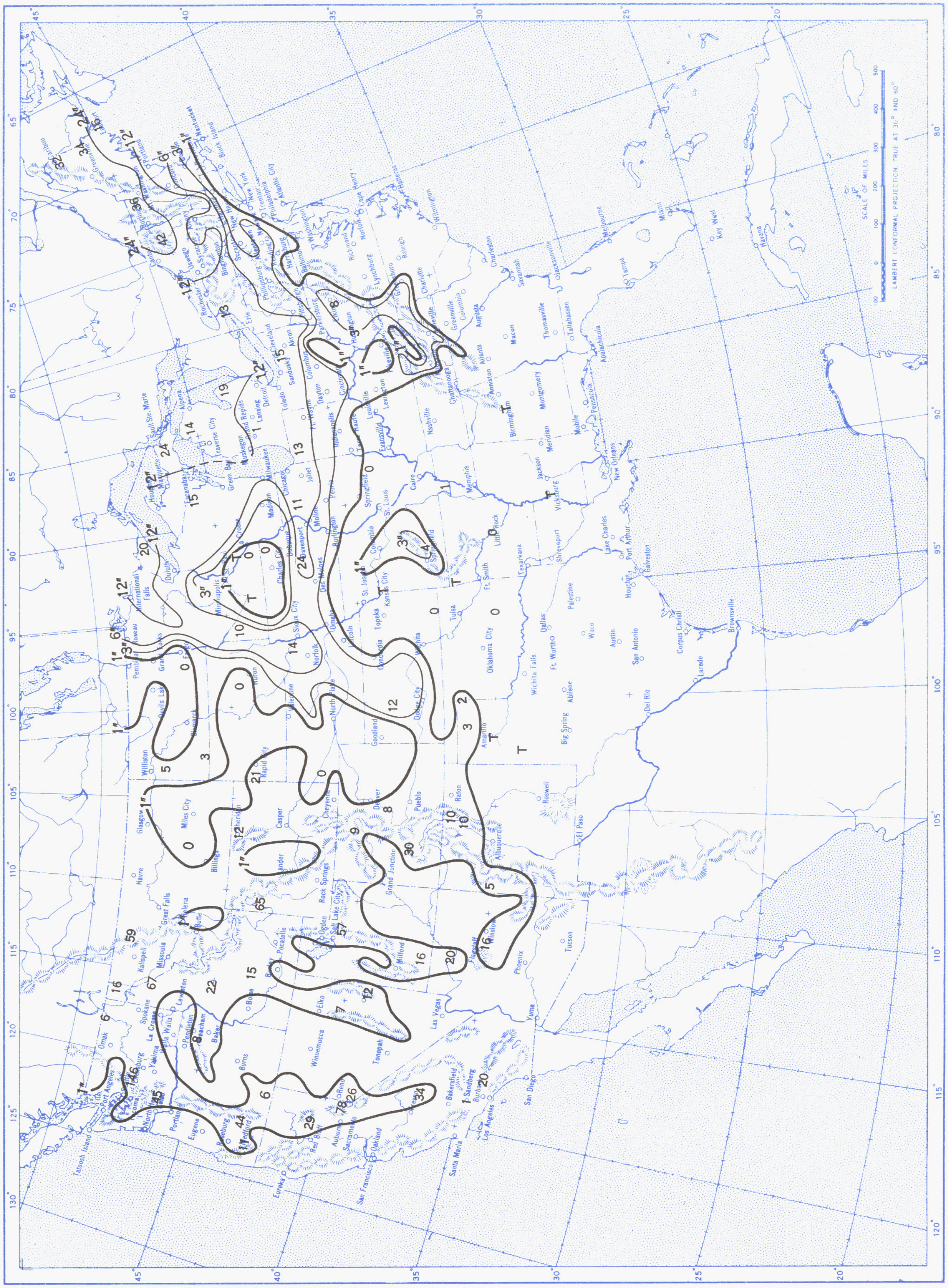


B. Percentage of Normal Precipitation, February 1954.



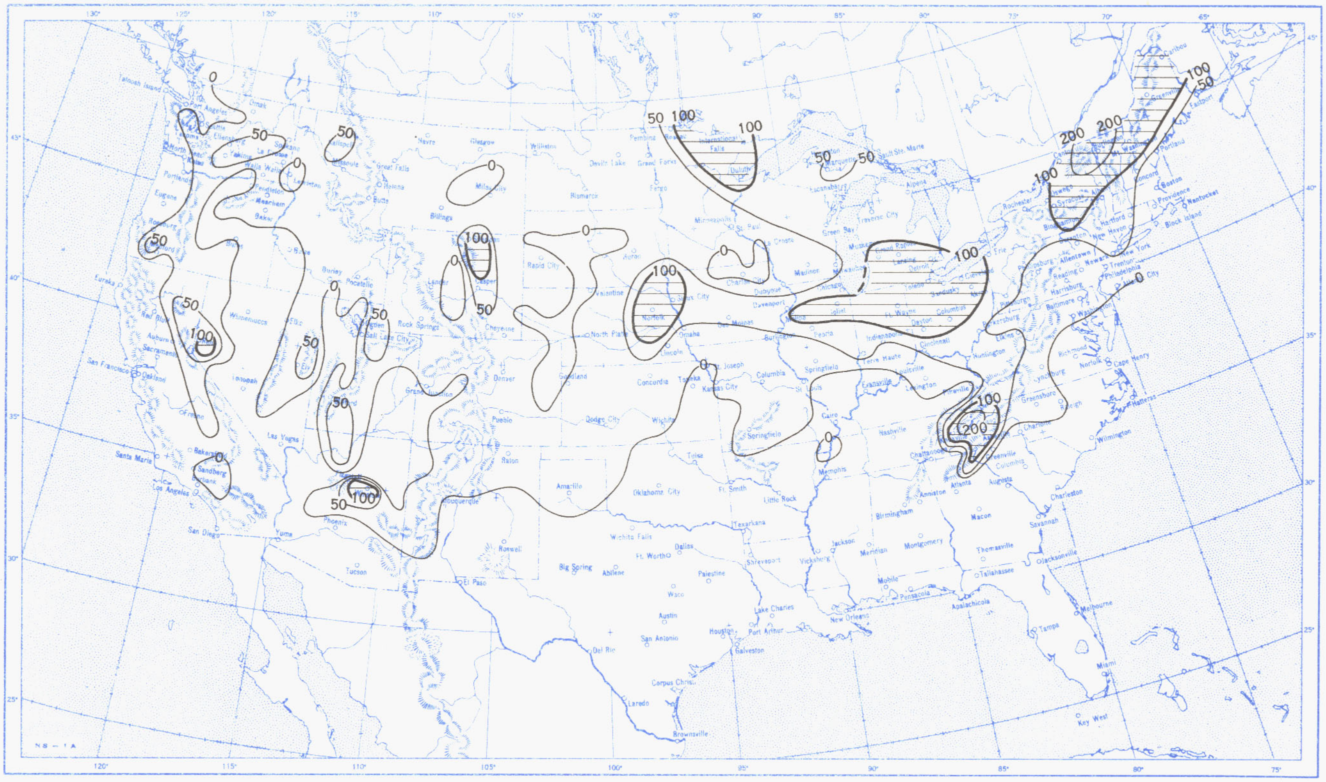
Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart IV. Total Snowfall (Inches), February 1954.

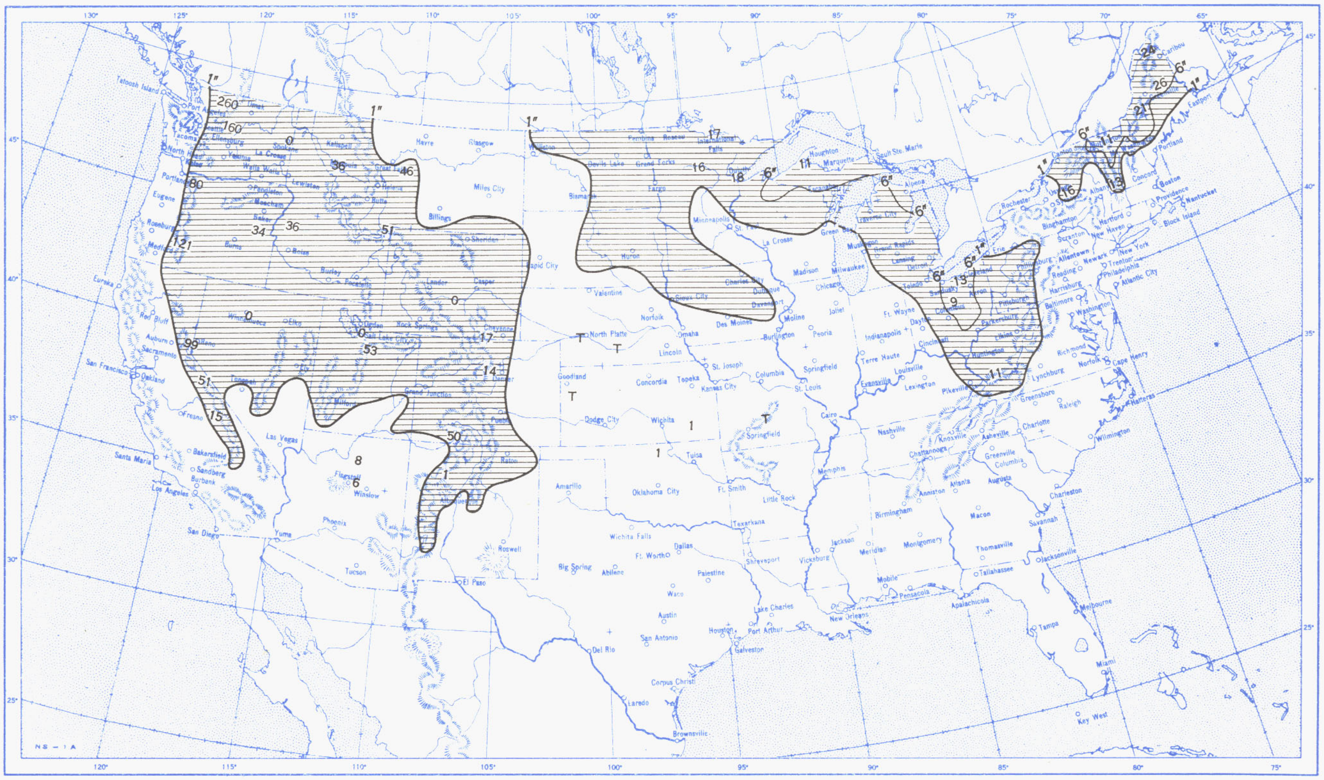


This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.

Chart V. A. Percentage of Normal Snowfall, February 1954.

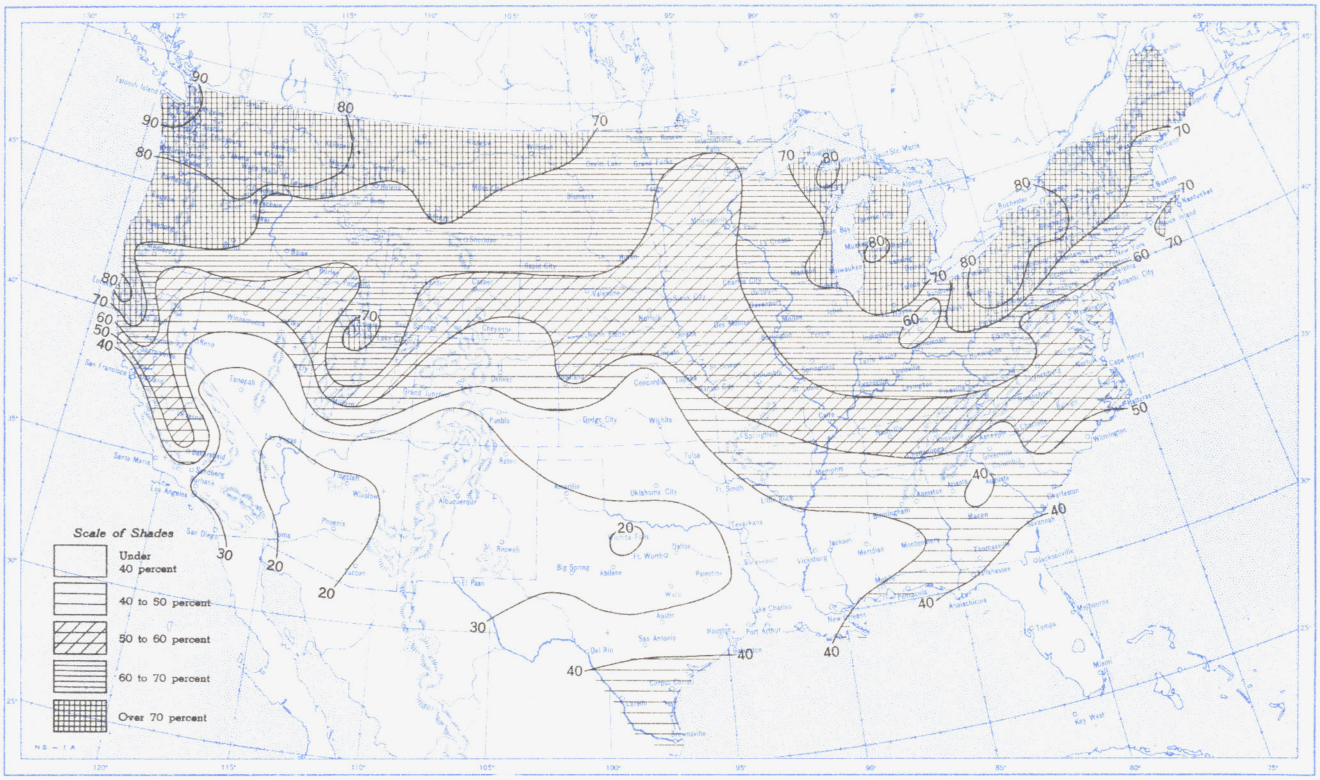


B. Depth of Snow on Ground (Inches), 7:30 a. m. E. S. T., February 23, 1954.

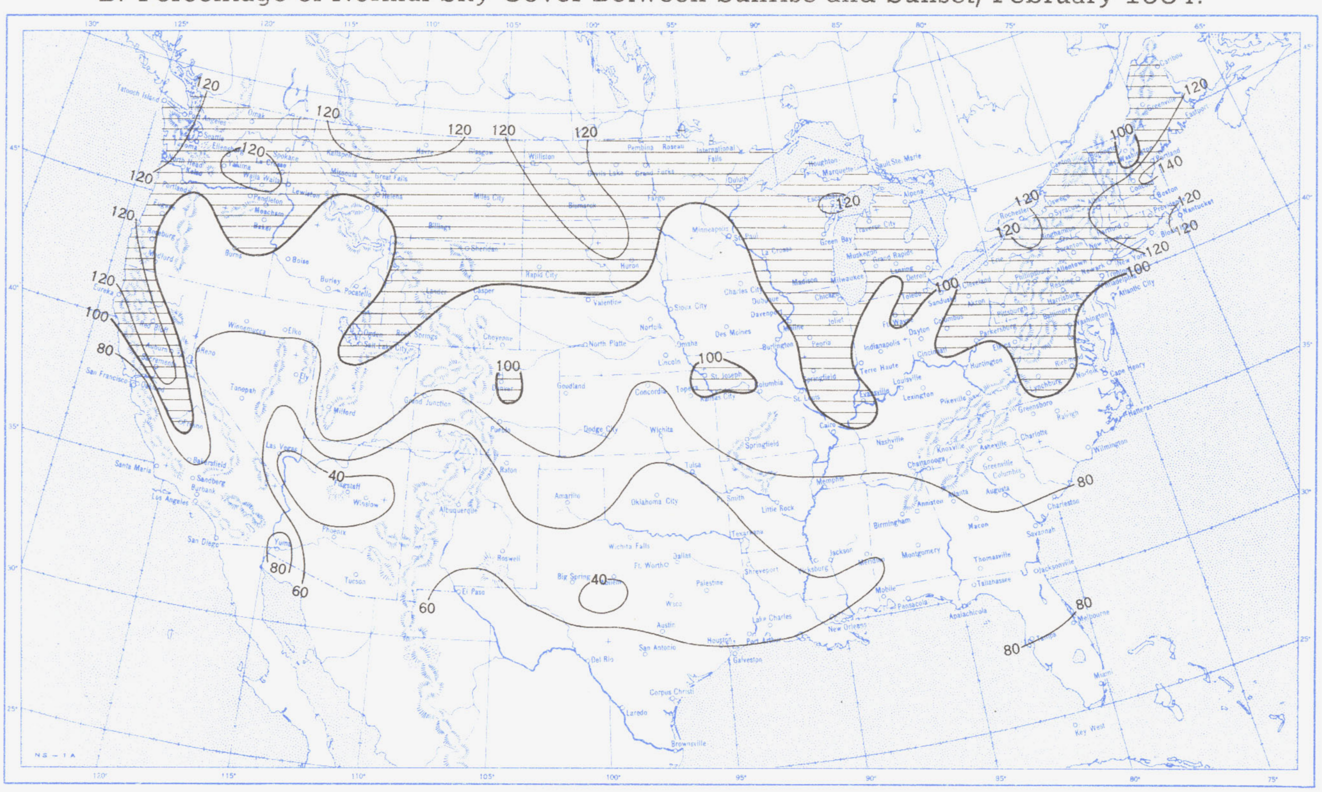


A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record.
B. Shows depth currently on ground at 7:30 a. m. E. S. T., of the Tuesday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, February 1954.

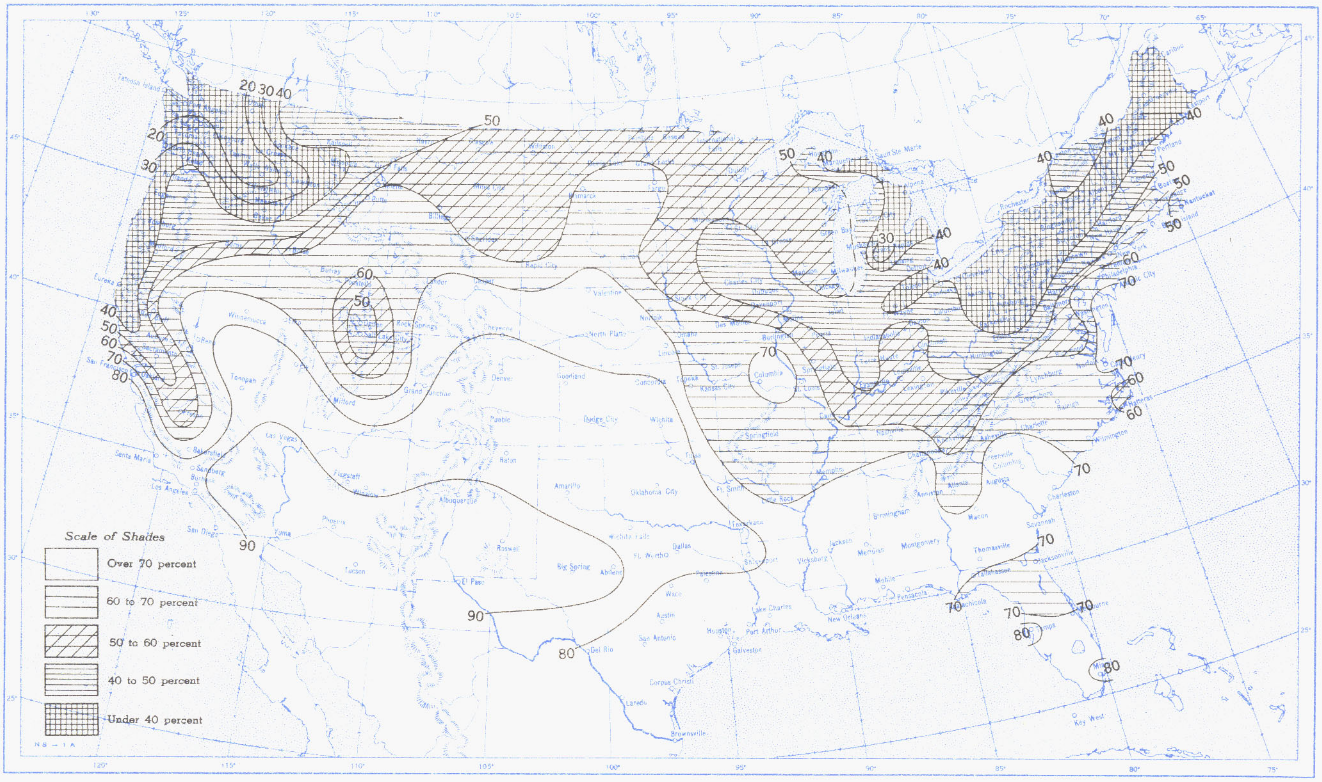


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, February 1954.

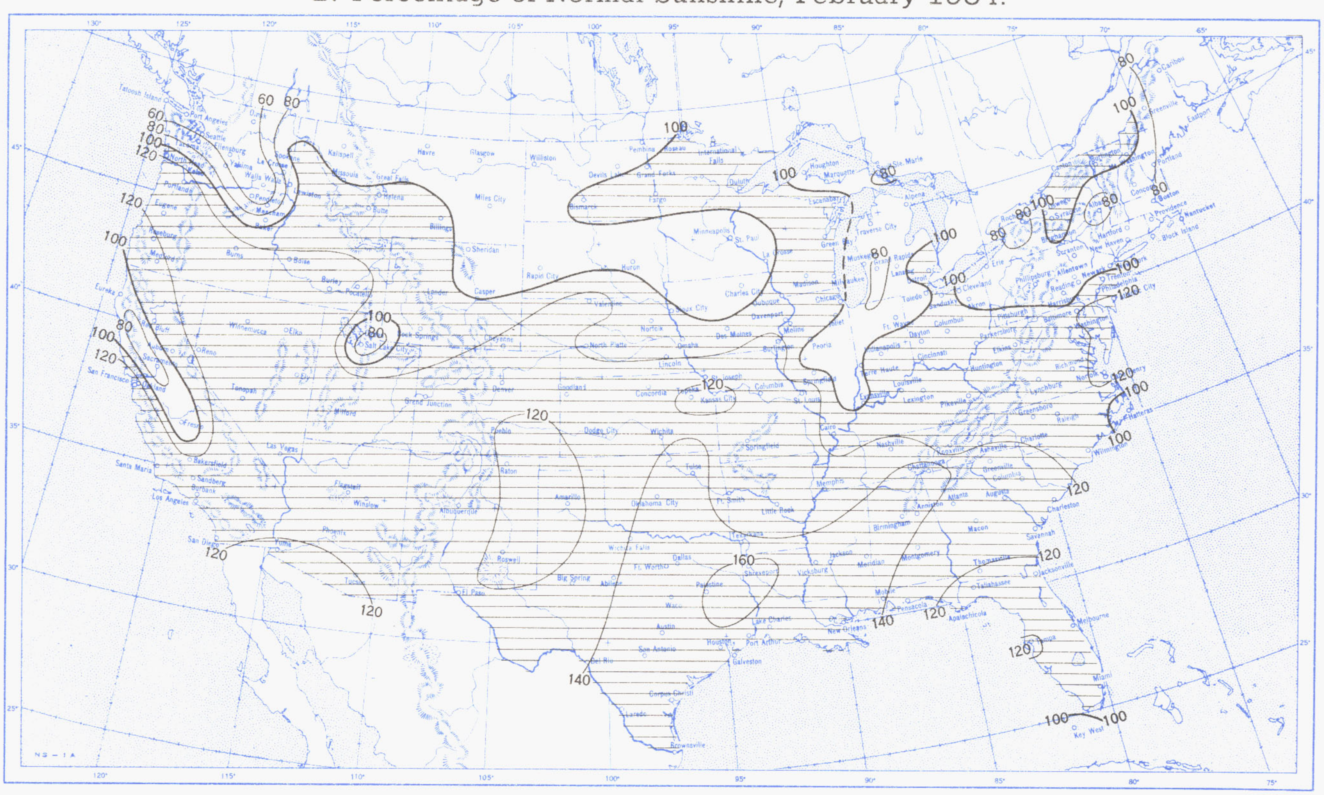


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, February 1954.



B. Percentage of Normal Sunshine, February 1954.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, February 1954. Inset: Percentage of Normal Average Daily Solar Radiation, February 1954.

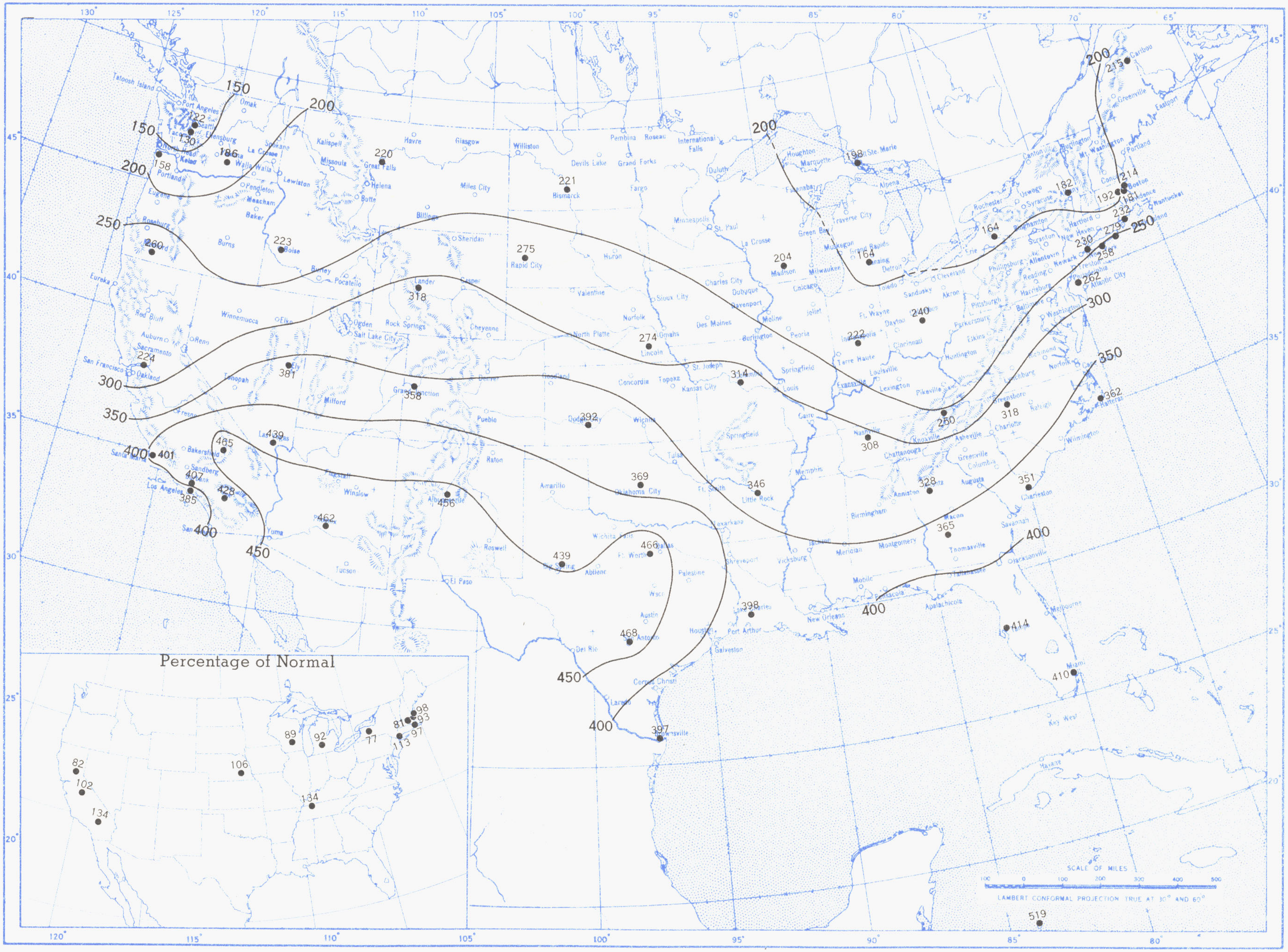
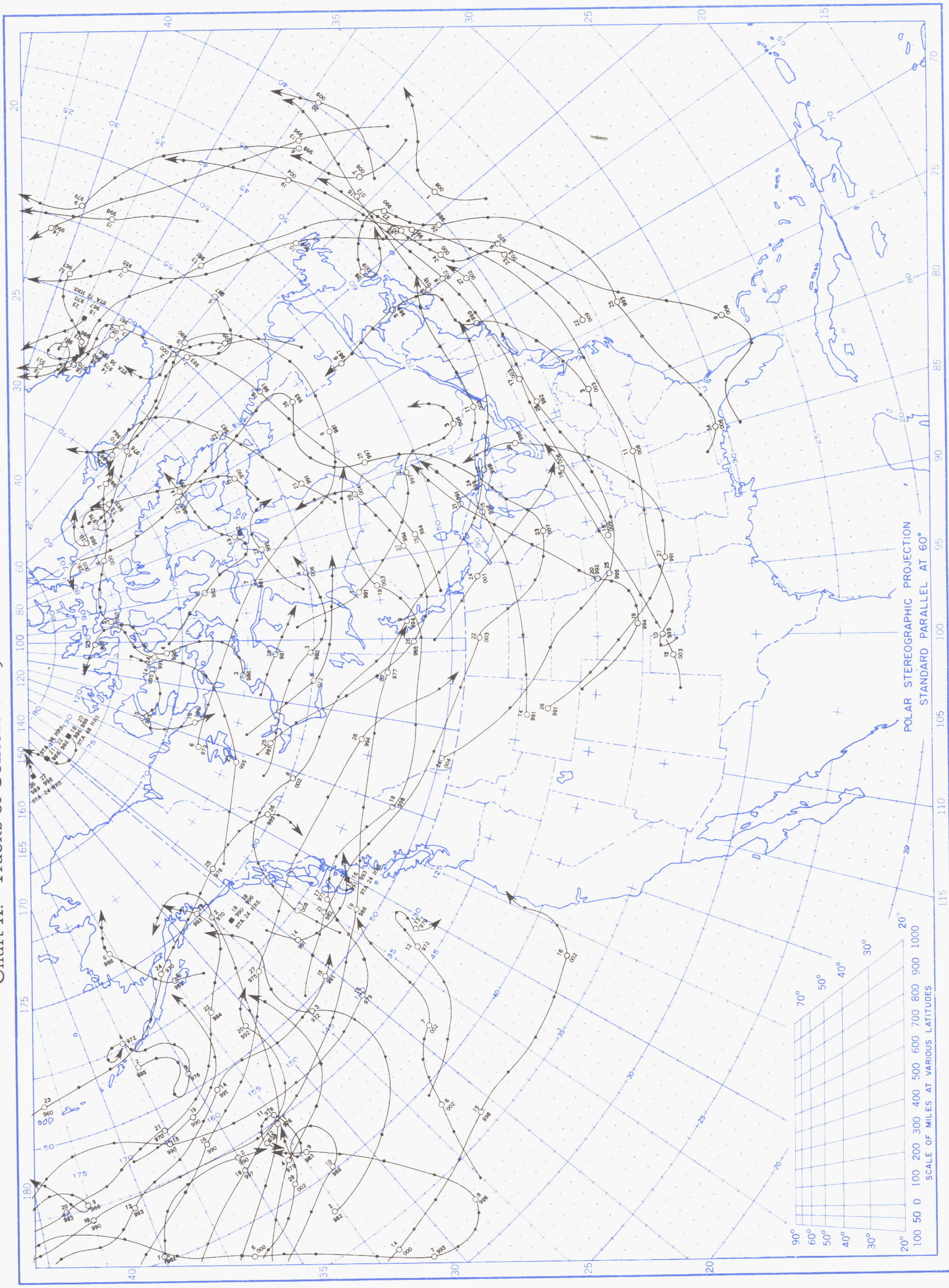


Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm. $^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, February 1954.

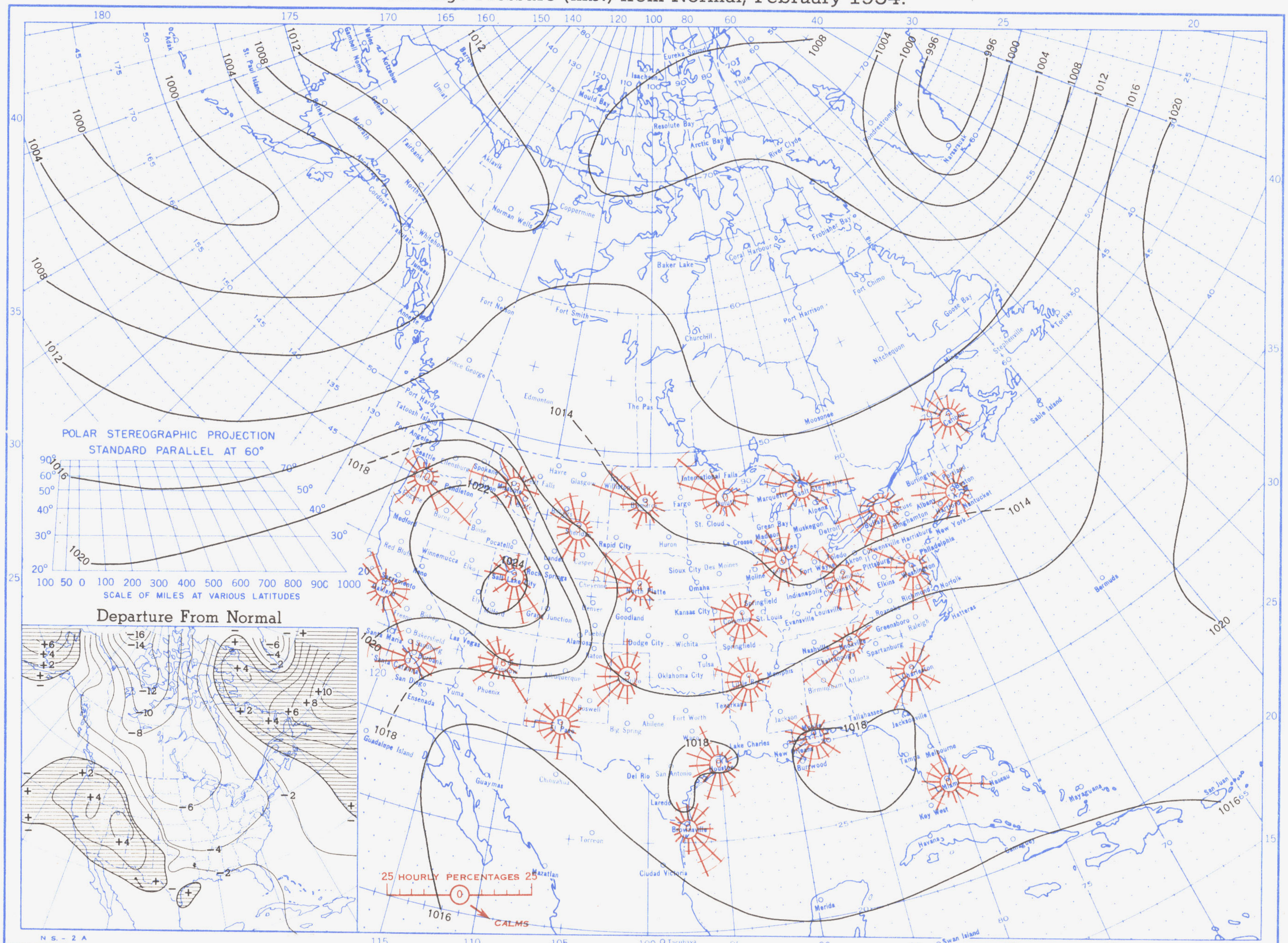
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, February 1954.



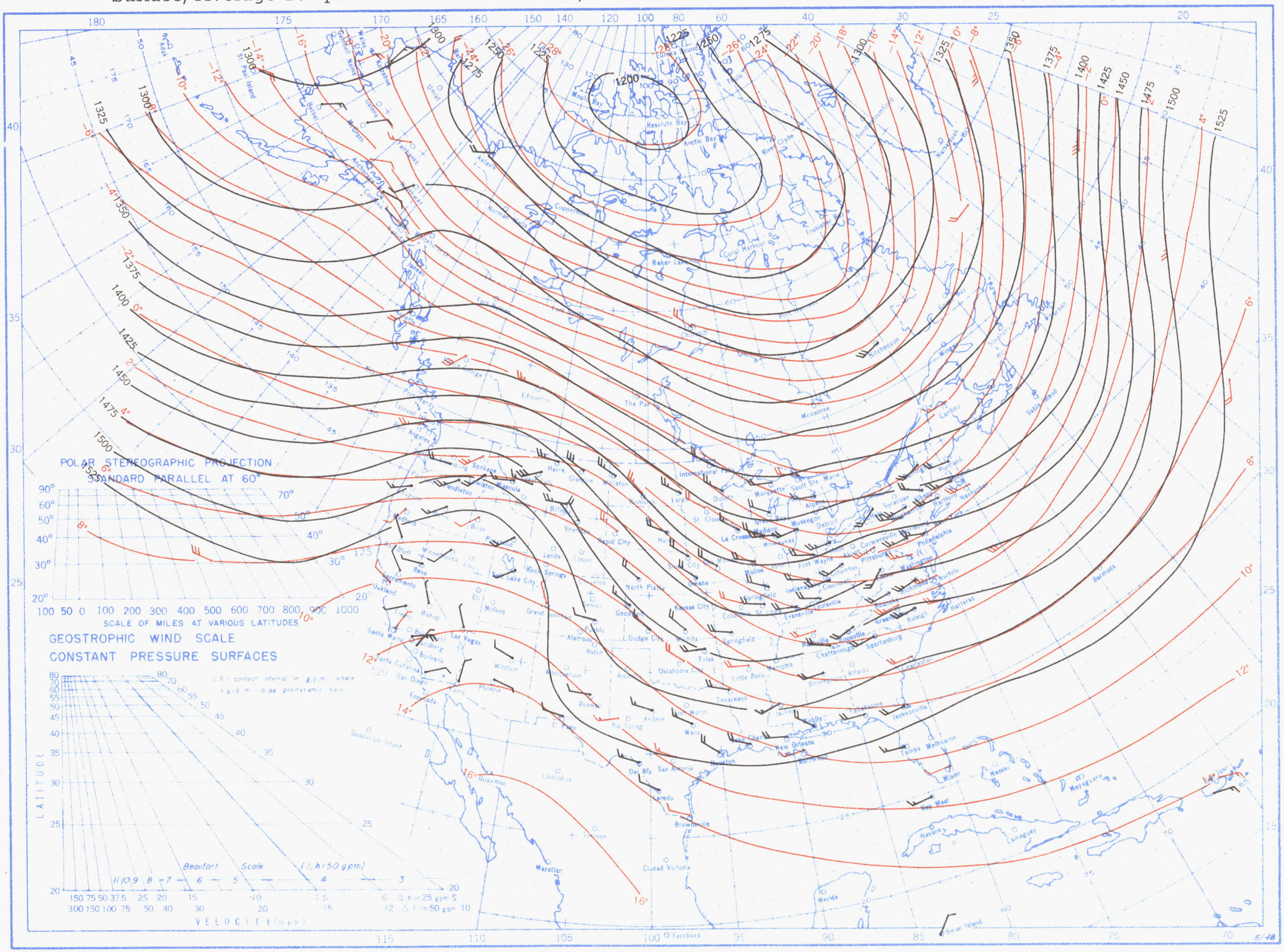
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, February 1954. Inset: Departure of Average Pressure (mb.) from Normal, February 1954.



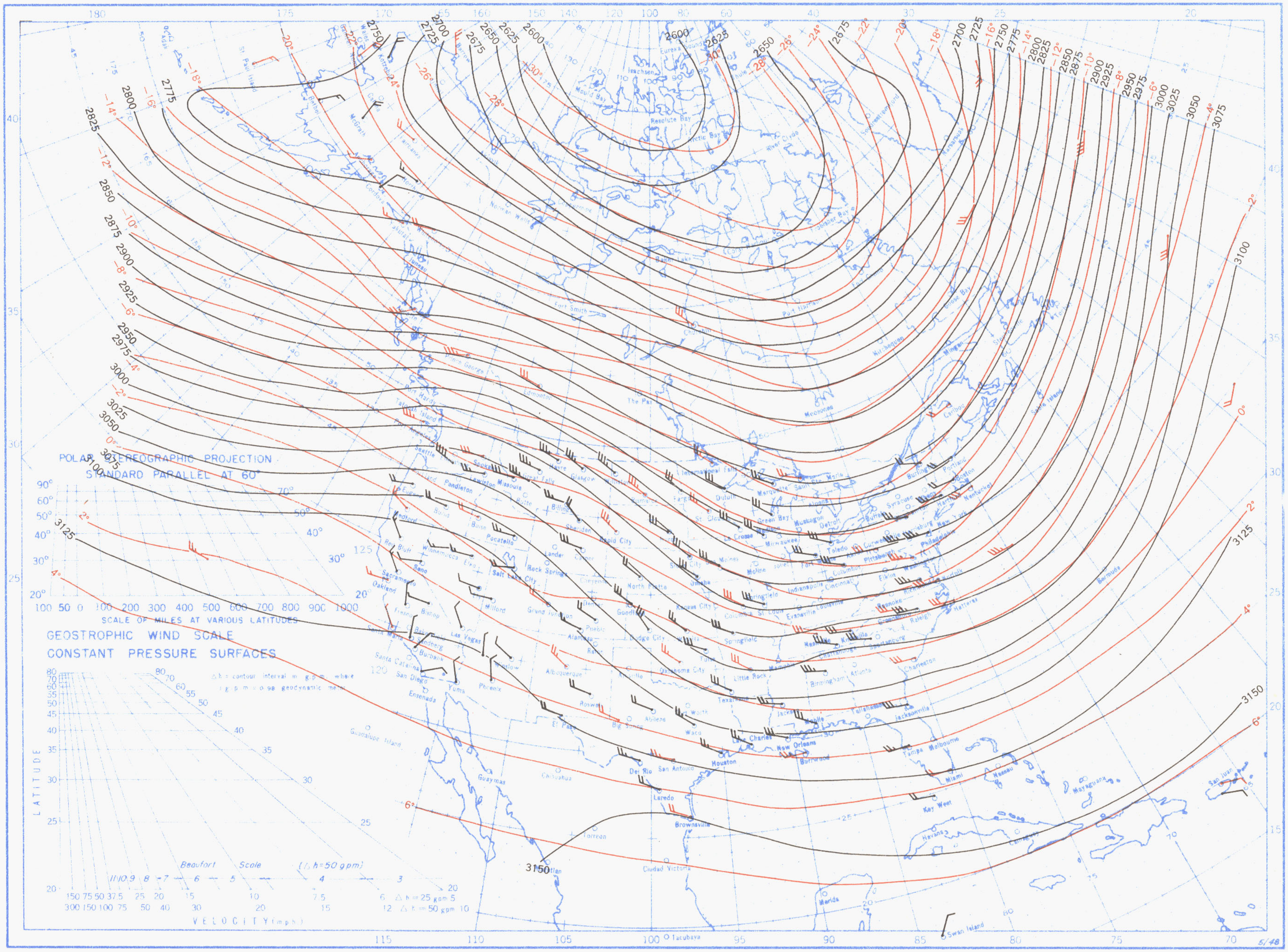
Average sea level pressures are obtained from the averages of the 7:30 a.m. and 7:30 p.m. E.S.T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), February 1954.



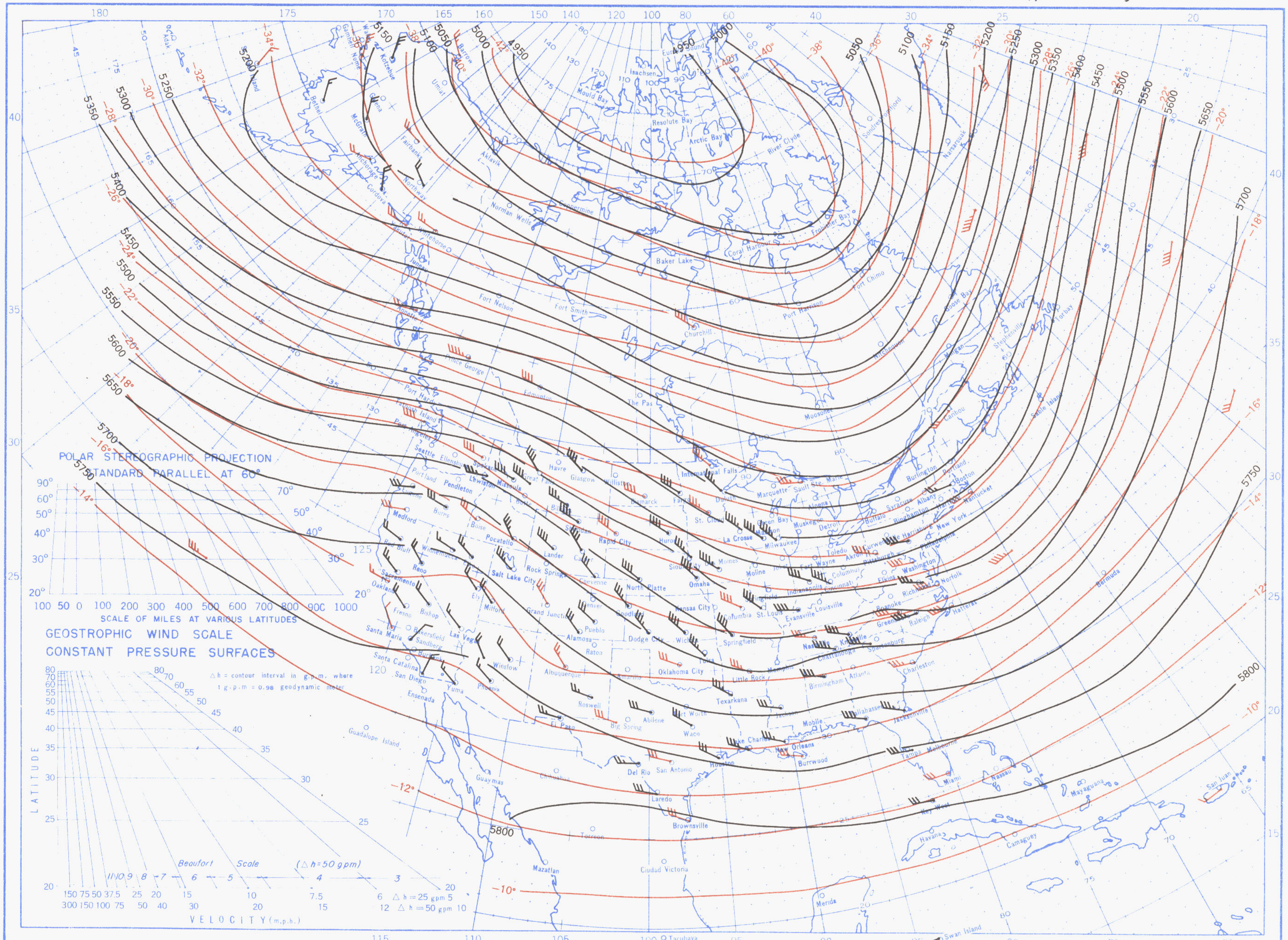
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m.. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), February 1954.



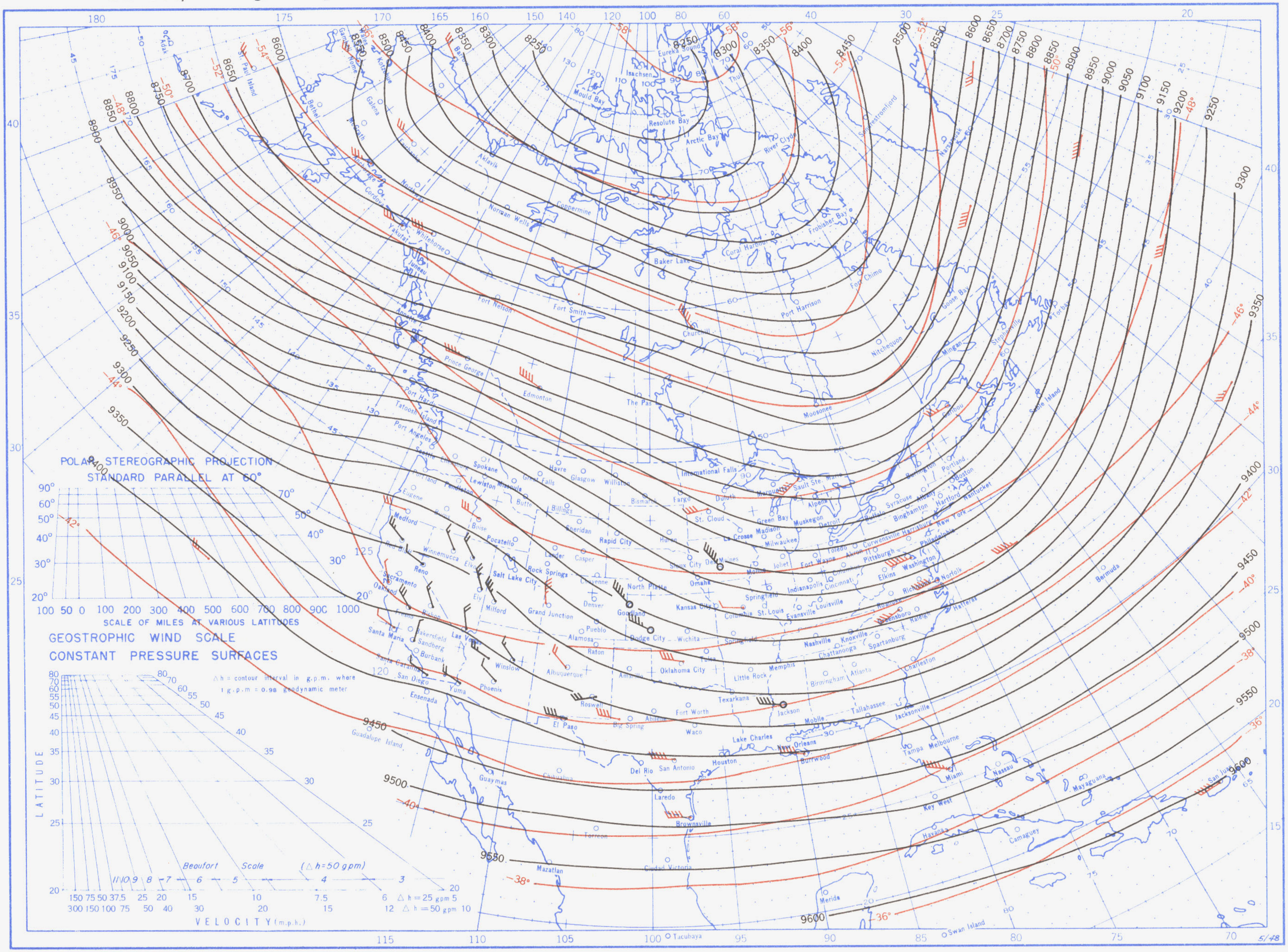
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), February 1954.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), February 1954.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.